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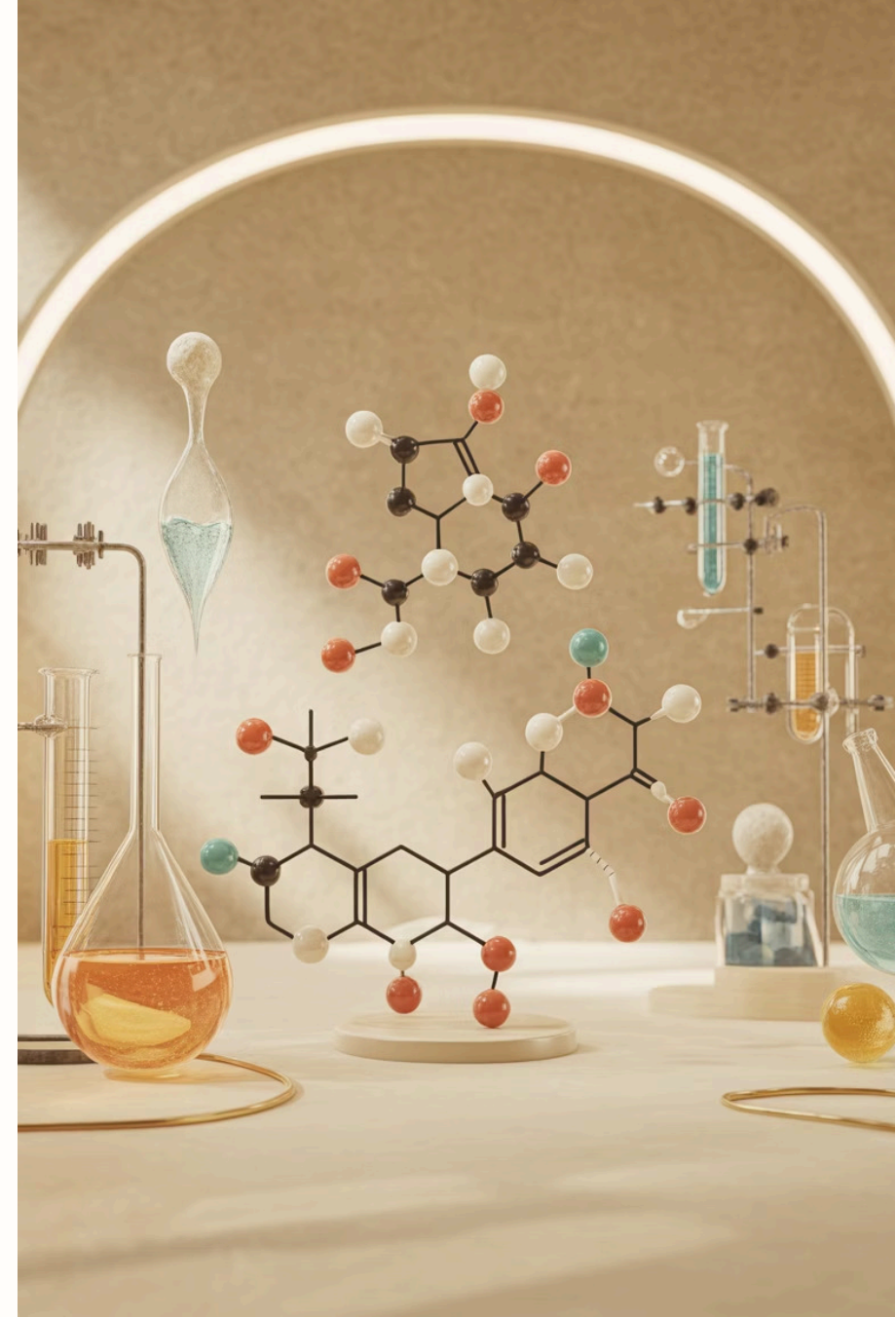
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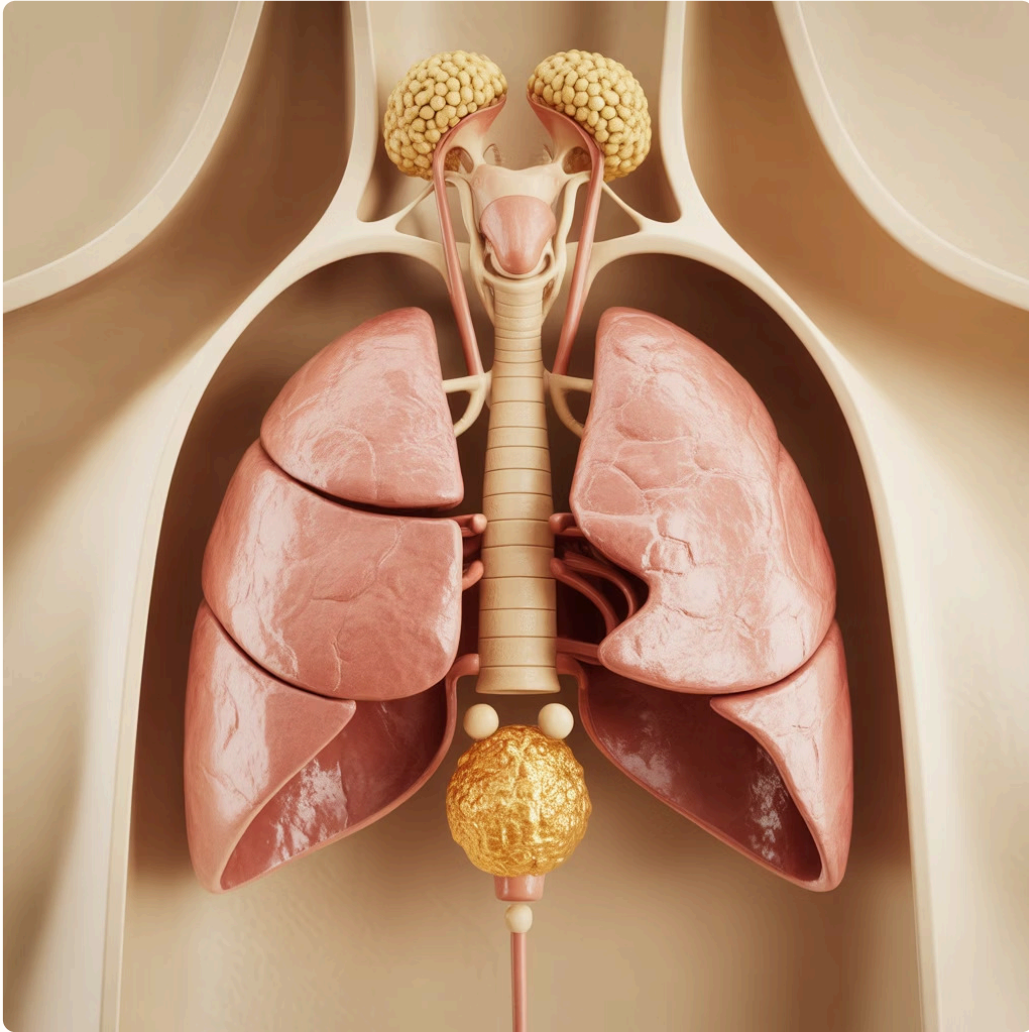
lecture (4)

Hormone Metabolism in Biochemistry

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What Are Hormones?



Hormones are powerful chemical messengers produced by specialised glands throughout the body. They travel through the bloodstream to reach distant target cells, where they bind to specific receptors and trigger important biological responses.

These remarkable molecules regulate virtually every aspect of our physiology, from how we process food for energy to how we grow, feel emotions, and reproduce.



Transport System

Hormones circulate through blood vessels to reach every corner of the body



Specific Targeting

Only cells with matching receptors respond to each hormone signal



Vital Regulation

Control metabolism, growth, mood, and reproductive functions

Key Hormones in Metabolism

Three major hormones work together to orchestrate metabolic balance and energy homeostasis in our bodies:

Insulin

The primary anabolic hormone that lowers blood glucose levels by promoting cellular uptake and storage of energy as glycogen and fat

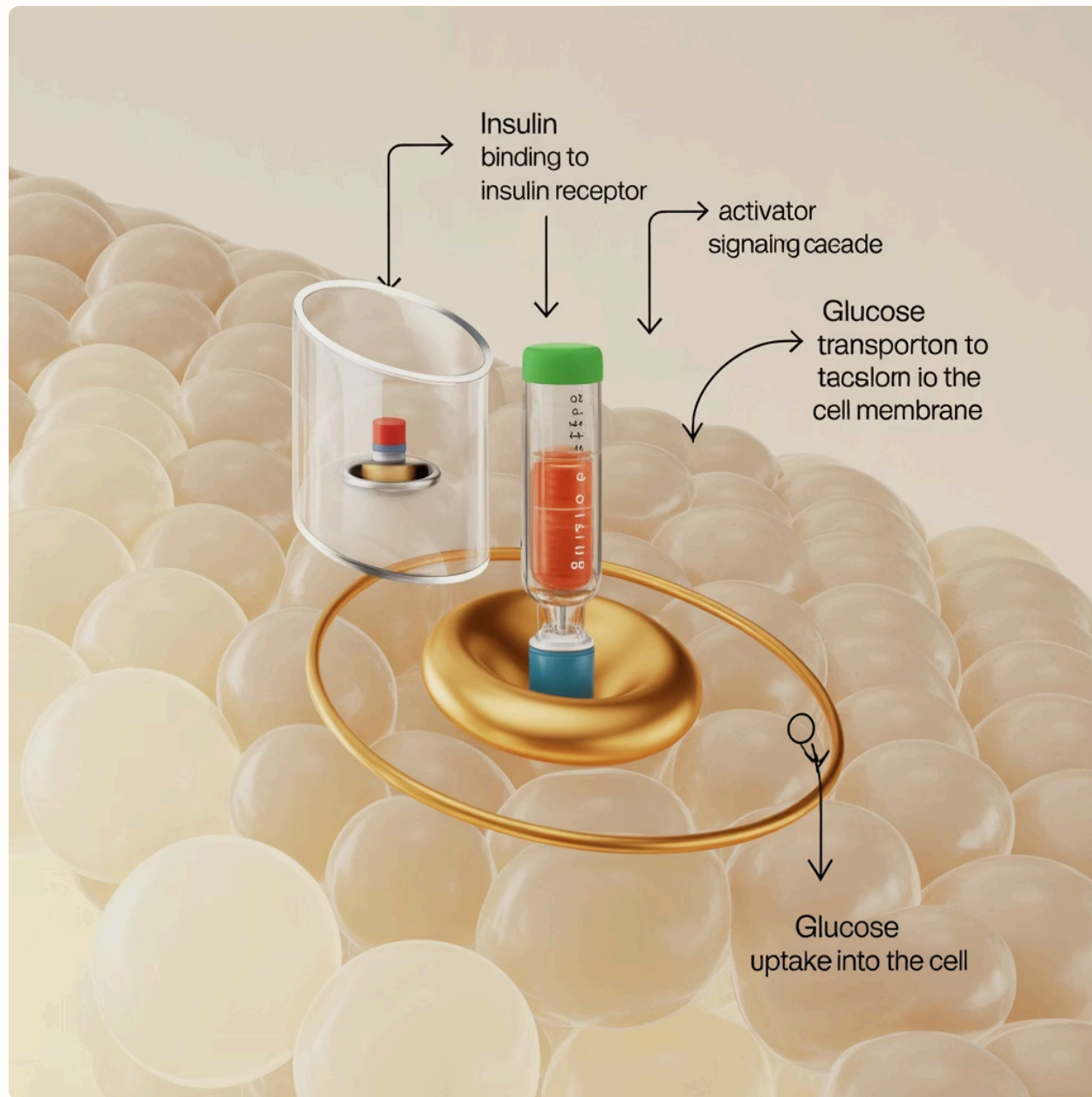
Glucagon

The catabolic counterpart that raises blood glucose by mobilising energy stores through glycogen breakdown and glucose synthesis

Thyroid Hormones

T3 and T4 regulate basal metabolic rate, controlling how efficiently cells use oxygen and produce energy

How Insulin Works: The "Storage" Hormone



Insulin's Metabolic Actions

- Secreted by pancreatic beta cells in response to elevated blood glucose after meals
- Binds to insulin receptors on muscle and adipose tissue, triggering glucose transporter movement
- Stimulates hepatic glycogen synthesis, converting excess glucose to storage form
- Promotes lipogenesis (fat synthesis) and protein anabolism
- Operates via negative feedback to maintain glucose homeostasis



Meal Consumption

Blood glucose rises after eating



Insulin Release

Pancreatic beta cells secrete insulin



Glucose Uptake

Cells absorb glucose from bloodstream



Balance Restored

Blood glucose normalises, insulin decreases

Glucagon: The "Energy Release" Hormone

Glucagon acts as the body's emergency energy mobiliser, ensuring adequate glucose supply during fasting states, exercise, or times of metabolic demand.

01

Secretion Trigger

Pancreatic alpha cells detect low blood glucose and release glucagon into circulation

02

Glycogenolysis

Glucagon stimulates hepatic glycogen breakdown, releasing stored glucose molecules into bloodstream

03

Gluconeogenesis

Liver synthesises new glucose from non-carbohydrate precursors like amino acids and lactate

04

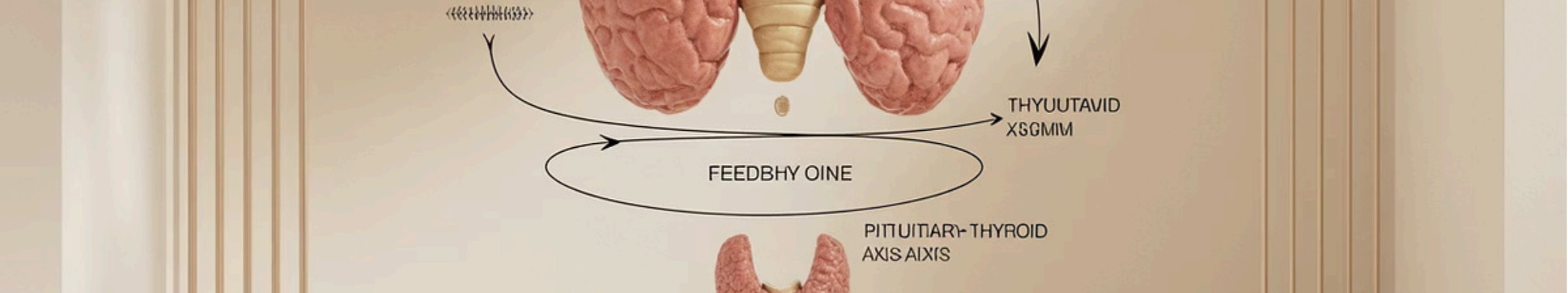
Blood Glucose Elevation

Released glucose raises blood sugar levels, providing fuel for brain and muscles

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Feedback Balance

Works in opposition to insulin, maintaining glucose homeostasis through reciprocal regulation

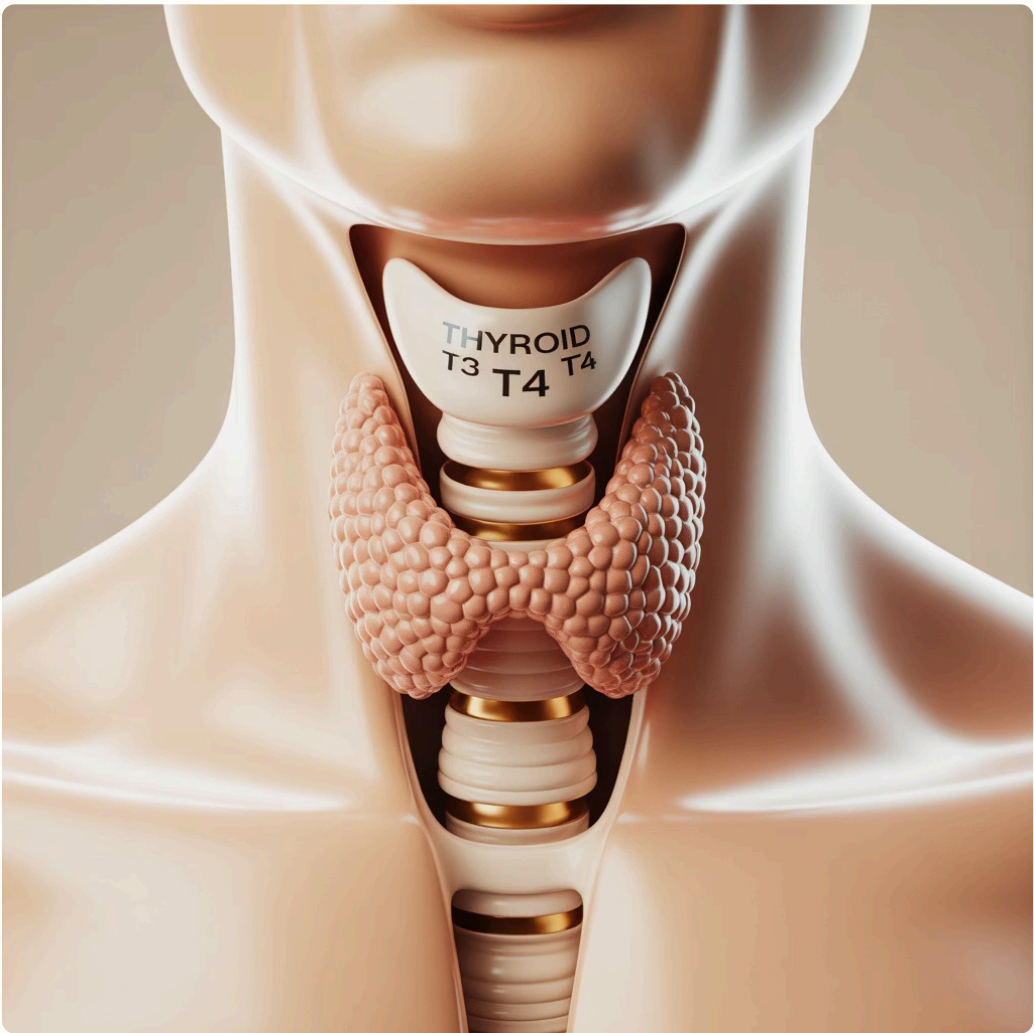


Thyroid Hormones and Metabolic Rate

Metabolic Master Regulators

The thyroid gland produces two critical hormones: triiodothyronine (T3), the active form, and thyroxine (T4), which serves as a prohormone reservoir.

These hormones profoundly influence cellular metabolism by increasing oxygen consumption, stimulating ATP production, and generating metabolic heat through mitochondrial activity.



Basal Metabolic Rate

T3 increases the rate at which cells consume oxygen and produce energy, directly controlling how many calories you burn at rest

Growth & Development

Essential for normal brain development in infancy, bone maturation, and protein synthesis throughout life

Thermogenesis

Stimulate heat production to maintain body temperature, particularly important in cold environments

HPT Axis Regulation

Controlled by hypothalamic TRH and pituitary TSH through sophisticated negative feedback mechanisms

Hormonal Regulation: Feedback Mechanisms

The endocrine system maintains exquisite balance through intricate feedback loops that prevent excessive or insufficient hormone production.

Detection
Sensors monitor hormone or metabolite levels

Feedback
System adjusts to maintain homeostasis



Signal

Changes trigger regulatory responses

Secretion

Glands adjust hormone production

Effect

Hormones produce physiological changes

Neural Control

Nervous system and circadian rhythms modulate hormone secretion patterns

Positive Feedback

Rare amplification loops used in specific scenarios like oestrogen surge triggering ovulation

Negative Feedback

Most common mechanism: high hormone levels inhibit further production (insulin/glucagon, TSH/thyroid hormones)

Disorders from Hormonal Imbalance

When hormonal regulation fails, profound metabolic disturbances can occur, affecting quality of life and overall health.



Diabetes Mellitus

Cause: Insufficient insulin production or cellular insulin resistance

Effects: Chronic hyperglycaemia, increased thirst, frequent urination, fatigue, long-term vascular damage



Hypoglycaemia

Cause: Excessive insulin or inadequate glucose intake

Effects: Dangerously low blood sugar causing shakiness, confusion, sweating, potential loss of consciousness



Hypothyroidism

Cause: Insufficient thyroid hormone production

Effects: Decreased metabolic rate, weight gain, cold intolerance, fatigue, depression, dry skin



Hyperthyroidism

Cause: Excessive thyroid hormone secretion

Effects: Elevated metabolism, weight loss, heat intolerance, anxiety, tremors, rapid heartbeat





Summary: Hormones Maintain Metabolic Balance

Metabolic Homeostasis

Glucose Homeostasis

Insulin and glucagon balance blood glucose for steady energy.

Metabolic Rate Control

Thyroid hormones (T3, T4) regulate metabolism, energy use, and body temperature.

Feedback Precision

Negative feedback loops maintain stable hormone levels, preventing fluctuations through constant adjustment.

Fundamental Balance

Hormonal balance is vital for energy, metabolism, and overall well-being. Imbalances affect growth, mood, and reproduction.

" ليس كل شيء يستحق الالتفات، فإن الحياة مليئة بالامور
التي لا تستدعي منك لحظة انتباه ، فلا تكثر التدقيق او
التفصيل فيما يستنزفك و لايزيدك، و احفظ وقتك و جهدك
للاهم ، واختر المواضع التي تنزف نفسك فيها بعناية تامة
، فإن اهتمامك ثمين ، فأعرف اين توجهه "

Remember: اقرؤو زين وراكم كوز:

